National Transportation Safety Board

Acquisition and Training: Informed by NTSB Accident Investigations

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Topics

- NTSB Basics
- Win-Win Benefits of Working Together
- Example: NextGen – Acquisition and Training Issues re
  - Advanced Technologies
  - Increasing Automation

NTSB 101

- Independent federal agency, investigate transportation accidents, all modes
- Determine probable cause(s) and make recommendations to prevent recurrences
- Determine cause, not blame or liability
- Independent
  - Political: Conclusions and recommendations based upon facts and evidence rather than politics
  - Functional: Impartial and unbiased because no “dog in the fight”

NTSB Recommendations

- NTSB primary product: Safety recommendations
- Implementation of recommendations is not mandatory, but more than 80% are acted upon favorably

Working Together: Eyes on the Same Prize

- Where you stand depends upon where you sit
- Perspectives
  - FAA: Holistic
  - NTSB: Safety
- Objectives
  - FAA: Improving safety
  - NTSB: Improving safety

Useful Information from Accident Investigations

- NTSB accident reports are public
- Not necessarily in reports:
  - Information that is not pertinent to the cause of that accident
  - Trends
- NTSB can inform the process with all of the above, whether in public reports or not

Examples of Working Together

- Commercial Aviation Safety Team (CAST)
- Infoshare
- Win-win – The safety improvement process benefits from accident investigation lessons learned, and the NTSB learns more about how things really work

NextGen

- Advanced Technologies
- Increasing Automation
- Both involve
  - Acquisition issues
  - Training issues

The Context: Complex Systems

- The NAS is a complex system
- NextGen will significantly change and improve the NAS
- Changing complex systems successfully can be very challenging
- The aviation industry has a complex system improvement success story: Commercial Aviation Safety Team (CAST)

The CAST Challenge: The "Plateau"

- Accident rate declined for decades
- Rate "plateaued" in early 1990's, many safety experts thought it could not improve much further
- Concern: FAA predicted volume of flying to double in 15-20 years
- Double volume x flat rate = Twice as many crashes
- Public concerned about *number* of crashes, not *rate*
- Solution: Voluntary industry-wide collaboration (CAST)

Collaboration

- Brings all parts of a complex system together to
  - Identify potential issues
  - *PRIORITIZE* the issues
  - Develop interventions for the prioritized issues
  - Evaluate whether the interventions are
    - Accomplishing the desired result, and
    - Not creating unintended consequences
- Kudos to NextGen for collaboration via the NextGen Advisory Committee

Collaboration Enables “System Think”

System Think: In a complex system of coupled subsystems, understanding how a change in one subsystem may affect some or all of the other subsystems

Success Story

- 83% decrease in stuck, flat aviation fatality rate, 1998 – 2007

AND

- Improved productivity while improving safety, contrary to conventional wisdom

AND

- Avoided unintended consequences

AND

- Collaboration created no new regulations

Major Paradigm Shift

– Old: The regulator (FAA) identifies a problem, develops solutions

- Industry skeptical of regulator's understanding of the problem
- Industry fights regulator's solution and/or implements it minimally and begrudgingly

– New: Collaborative "System Think"

- Industry involved in identifying problem
- Industry "buy-in" re interventions because everyone had input, everyone's interests considered
- Prompt and willing implementation
- Interventions evaluated . . . *and tweaked as needed*
- Solutions probably more effective and efficient
- Unintended consequences much less likely

Moral of the Story

Anyone who is involved in the *problem* should be involved in developing the *solution*

Challenges of Collaboration

- Human nature: "I'm doing great . . . *the problem is everyone else"*
- Participants may have competing interests, e.g.,
  - Labor/management issues
  - May be potential co-defendants
- Regulator probably not welcome
- Not a democracy
  - Regulator must regulate
- Requires all to be willing, *in their enlightened self-interest,* to leave their "comfort zone" and think of the System rather than just their individual interests

TRUST

Manufacturer Collaboration

Aircraft manufacturers obtain input, throughout the design process, from

- *Pilots* (*User* Friendly)
- *Mechanics* (*Maintenance* Friendly)
- *Controllers* (*System* Friendly)

Challenge With New Technologies

- Controllers often complain to media about new equipment
- Were controllers adequately included in development phase? Pilots and others?
- NextGen improvements such as space-based ADSB, data comm, and remote control towers: Developed with collaborative process involving end-users and others?
- Acquisition challenge re advanced technologies: Adequate collaborative inclusion of end users and others throughout the process

NTSB Can Help Inform the Process

- NTSB has investigated many accidents in all modes of transportation involving issues regarding the introduction of new technologies
- We can inform the process with accident lessons learned to help avoid bumps in the road re NextGen new technology improvements

Increasing Automation

- NextGen will also involve increasing automation
- Automation has improved safety, productivity, reliability, efficiency
- The theory: Removing the human operator will remove human error

Prof. James Reason

In their efforts to compensate for the unreliability of human performance, the designers of automated control systems have unwittingly created opportunities for new error types that can be even more serious than those they were seeking to avoid.

Reason, James, Managing the Risks of Organizational Accidents (Ashgate Publishing, 1997), p. 46

Problems With the Theory

- Two challenges of automation
  - Failure
    - Fail safe?
    - If not, will the system ensure that the operator is aware of the failure in time to take over?
    - Example: Metro Fort Totten accident, 2009
  - Unanticipated situations
    - Landing on the Hudson
    - Sioux City
- Other humans in the system
  - Designers, manufacturers, maintainers
    - Example: Airport people mover collision
  - Pilots

Human Roles in Automation

- The human is the least predictable and most unreliable part of the system
  - Colgan
  - Air France 447
- The human is also the most adaptable part of the system
  - Sioux City
  - Landing on the Hudson

Problems With Automation

- Mode confusion: What's it doing now?
  - Example: Cali, Colombia
- Degradation of skills
  - Example: Asiana 214
- Complacency
  - Example: Bedford, MA
- Reduced professionalism?
  - Stay tuned

Roles of Acquisition and Training

- Acquisition: Robust engineering
  - Minimizes likelihood of human error
  - Maximizes tolerance for human error

And because the engineering can never be perfect, remainder of solution consists of

- Training: Helps with
  - Threat and error management
    - Reduce errors and mitigate effects of errors
  - Automation failures
    - Train by rote?
    - Train to understand system?
  - Unanticipated situations
  - Complacency

NTSB Can Help Inform the Process

- NTSB has investigated many accidents in all modes of transportation involving issues regarding the introduction of automation into complex human-centric systems
- As with new technologies, we can inform the process with accident lessons learned to help avoid bumps in the road re NextGen increases in automation

Conclusions

- NextGen will encounter significant issues re introducing new technologies and increasing automation

- Lessons learned from accidents can be helpful in addressing these issues

Thank You!!

Questions?